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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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EXAMINER	
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ART UNIT	PAPER NUMBER
2815	

DATE MAILED: 09/17/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/924,209	GUNAPALA ET AL.	
	Examiner	Art Unit	
	B. William Baumeister	2815	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *02 July 2004*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-11* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-11* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *12 May 2003* is/are: a)☐ accepted or b)☒ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date *7/2/04*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Specification

1. At page 6 the specification states that "FIG 4 shows the calculated magnitude of the coupled radiation with its electric field (Ez)..." and "FIGs 5 and 6 respectively show the calculated electric fields (Ez)..." However, it is unclear what portion(s) of FIGs. 4-6 are intended to represent the respective electric fields.

Appropriate correction is required.

Drawings

2. The drawings are objected to because:

a. At page 6 the specification states that "FIG 4 shows the calculated magnitude of the coupled radiation with its electric field (Ez)..." and "FIGs 5 and 6 respectively show the calculated electric fields (Ez)..." However, it is unclear what portion(s) of FIGs. 4-6 are intended to represent the respective electric fields.

b. Figures 3 and 4 possess no indication of what the white serpentine region that is positioned between the grating teeth and the quantum well stack is intended to represent.

i. On 5/12/03, Applicant previously amended only Fig. 3 to label the previously unlabeled white serpentine region as element 116. However, the specification and FIG 1 indicates that element 116 is the doped-GaAs contact layer. If this is what Applicant in fact intended, it is unclear how the contact layer is formed in the serpentine configuration of FIGs 3-5 in light of the specification's

teaching that the diffraction slits 120 are formed after the formation of the contact 116.

ii. In the subsequent response of 11/26/03, Applicant alternatively stated, "the white serpentine region should represent the electric field distribution in that region rather than the physical embodiment of the contact layer 116, although the contact layer 116 is located in that area. The undersigned suggests that '116' be removed."

(1) The examiner is not persuaded that the serpentine region represents an electric field because accepted physics principles dictate that an electric field would not take on such an orientation in the structure as claimed.

(2) Also, FIG 6 does not possess a serpentine line even though the specification states that the embodiment depicted by FIG 6 possesses an associated electric field.

(3) Moreover, even assuming *arguendo*, that the white serpentine line is an electric field, the drawings still fail to depict where the contact layer 116 is supposed to exist.

c. FIGs 4 and 5 possess an unlabeled dashed rectangle. It is unclear what these rectangles are supposed to represent.

i. As applicant urges that the white serpentine line represents the electric field, the dashed rectangles must represent something else.

ii. Alternatively, if they do represent the electric field, the drawings would conflict with the specification because the specification states that the electric

field is greater in the FIG 5 embodiment than the FIG 4 embodiment, and that the FIG 6 embodiment also possesses an electric field.

d. **Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application.** Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. The figure or figure number of an amended drawing should not be labeled as "amended." If a drawing figure is to be canceled, the appropriate figure must be removed from the replacement sheet, and where necessary, the remaining figures must be renumbered and appropriate changes made to the brief description of the several views of the drawings for consistency. Additional replacement sheets may be necessary to show the renumbering of the remaining figures. The replacement sheet(s) should be labeled "Replacement Sheet" in the page header (as per 37 CFR 1.84(c)) so as not to obstruct any portion of the drawing figures. If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. **The objection to the drawings will <u>not</u> be held in abeyance.**

Claim Rejections - 35 USC § 103

3. The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

4. Claims 1-3, 5-8 and 10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Choi '015 (previously made of record) in view of Chen et al., "Corrugated Quantum Well Infrared Photodetectors with Polyimide Planarization for Detector Array Applications," IEEE Transactions on Electron Devices, Vol. 45, No 7, July 1998, pp. 1431-1437 (previously made of record).

a. Choi '015 discloses quantum grid infrared photodetectors (QGIPs) wherein diffraction slits 251 are etched into the (Al)GaAs MQW detector region to form single-slit diffraction units. The presence of the diffraction slits forms an optical grating that improves the sensitivity of the IR detector by coupling more incident radiation into the detector relative to that of a convention quantum well infrared photodetector (QWIP) which does not possess the slits. Specifically, Choi teaches that the sensitivity is greater than prior art QWIPs because in QGIPs "the optical area includes both the etched and un-etched areas (i.e., the areas of stacks S including cavities 251), while the detector area only includes the un-etched areas of stacks S. Because photocurrent is directly proportional to the optical area, and the dark current, which produces noise, is directly proportional to the detector area, detector sensitivity increases when the detector area is reduced without reducing the optical area, as is the case of the present invention." (Col. 8, lines 52-62). Choi also teaches that the diffraction slits may be formed either by plasma etching wherein the cavity sidewalls are straight (e.g., FIGs 5 and 9 and col. 6, lines 40-) or alternatively by wet etching—the same etching method employed by Chen, discussed hereinbelow—wherein the cavity sidewalls form a pyramidal slope in one crystal

direction and an inverted pyramidal slope in the orthogonal crystal direction (e.g., Figs 13- 1 5 and col. 9, line 19-).

b. Choi does not anticipate the claims because the reference teaches l-dimensional (1-D) slits (e.g., FIG 6) as opposed to 2-dimensional slits (i.e., producing fully-isolated-stack columns) as set forth in the independent claims.

c. Chen teaches GaAs-based corrugated quantum well IR photodetectors (C-QWIPs) formed on a transparent substrate and having either I-D V-grooves or alternatively 2-D V-grooves producing fully-isolated, diffractive-grating detector pixel columns, each comprising a lower contact layer, a MQW detection region and an upper contact layer. A metal contact is formed over the top contacts. (See e.g., Fig 1, showing the 1-D slit embodiment). Further, Chen discloses that the lower contact is overetched (e.g., p. 1434, col. 2), indicating that the lower contact also extends into the column. The grooves are filled with an insulating material such as polyimide. The refractive index of GaAs is 3.1 and that of polyimide is 1.6 (p. 1434, col. 2). Chen does not anticipate the claims because the reference only teaches the use of wet etching (which forms the sloped sidewalls) as opposed to the use of plasma-etching (which produces straight sidewalls).

d. It would have been obvious to one of ordinary skill in the art at the time of the invention to have modified the 1-D groove QGIP structure of Choi '015 by further adding Choi's plasma-etched grooves in a second dimension, thereby forming a 2-D groove structure as taught by Chen (thus producing isolated quantum-stack columns) for the purpose of even further reducing the ratio of the detector area to the optical area and thereby increase the sensitivity as taught by Choi '015.

Further, Chen teaches that when using sidewalls formed by wet-etching, the performance of the 2-D QGIPs (detectors C and D) is inferior to that of the I-D QGIPs (detectors A and B) because while the V-shaped grooves of the one groove direction are beneficial, the presence of the inverted V-shaped groove of the orthogonal direction reduces absorption (page 1435, col. 1). Chen also teaches that in order to fully exploit the potential of the QGD, more effort is need to investigate how the coupling efficiency can be affected by various sidewall profiles, created by various etching methods (page 1436, col. 2).

As such, it would have been further obvious to the skilled artisan, when modifying the Choi '015 QGIP so as to form a 2-D groove QGIP, to have specifically employed plasma etching as opposed to wet etching--and thereby form vertical sidewalls instead of slanted sidewalls--for the purpose of preventing the decrease in absorption efficiency that results from the inverted pyramid profile that is associated with the wet-etching process.

e. Regarding claims 2 and 7 setting forth a plurality of separate metallic elements respectively formed over said plurality of quantum well structures, note for example FIGs 1a-c, wherein the bottom contact layer serves as the common contact, and a plurality (only one is depicted for clarity) of metal contacts are separately formed over respective, separate sections of plural quantum well structures.

5. Claims 4, 9 and 11 are rejected under 35 U.S.C. 103(a) as being unpatentable over Choi '015/Chen as applied to the claims above and further in view of Choi '469 (previously made of

record). Choi '015 teaches that QGIPs are responsive to a broader range of wavelengths than QWIPS and can therefore be employed in multi-color detection applications (e.g., col. 8, lines 12-). Chen discloses that the C-QWIPS may be used for multicolor detection and expressly discloses an embodiment wherein a second QWIP is stacked upon a first QWIP by means of an interposed common contact layer; but therein the corrugations are only formed into the upper QWIP due to the large thickness of the combined QWIPs.

a. Choi '469 teaches that it was known to provide multi-color QWIPs wherein the respective wells for detecting the different wavelengths are interlaced, instead of forming one set on top of the other, thereby eliminating the intermediate third, common contact. It would have been obvious to one of ordinary skill in the art at the time of the invention to have employed a multicolor QGIP having the respective wavelength wells provided interlaced instead of formed in separate portions of the stack for the purpose of reducing the total thickness and simplifying the wiring requirements by eliminating the need for a third, common contact layer.

Response to Arguments

6. Applicant's arguments filed 7/2/04 have been fully considered but they are only partially persuasive.

a. The examiner's new-matter objection to the specification is withdrawn.

b. **Drawings:** Applicants stated that they are considering the objections to the drawings, are working on formal drawings that will overcome the objections, and respectfully request additional time for correcting the drawing informalities, as the

examination of the pending claims on the merits is not affected by the indicated formalities.

i. The issue is not whether correction of the drawings affects the merits of the claims. Rather, the issue is whether Applicant is making a bona fide attempt to advance prosecution. Please note that Rule 37 CFR 1.85 expressly states:

> Unless applicant is otherwise notified in an Office action, objections to the drawings in a utility or plant application will **not** be held in abeyance, and a request to hold objections to the drawings in abeyance will **not** be considered a *bona fide* attempt to advance the application to final action (§1.135(c)).

ii. As a courtesy, the examiner has waived this rule's requirement **this one time only. This rule's requirements will NOT be waived again; a good faith effort must be made in response to this Office Action to correct or respond to all outstanding drawing objections.**

MERITS:

7. Applicant asserts that the Choi '015 QGIP is different than the present invention because Choi uses each pixel feature as a single optical element, without optical coupling with other pixel features to redirect light, that in Choi the cavity 251 is sized so that the cavities form independent single-slit diffraction units, and that there cannot be optical coupling between adjacent cavities. This argument is not persuasive.

a. See e.g., FIG 9 depicting that the slits and stacks function cooperatively with the various features being optically coupled. Choi's single-slit diffraction units are termed "independent" because—contrary to the prior art QWIPS—Choi's device does not require

coherent interference effects on the grooves in the grating to operate properly (e.g., col. 8, lines 1-11).

8. Applicant argues that Chen teaches away because that device employs non-vertical corrugations for the sidewalls and operates by total internal reflection. This argument is not persuasive Chen was not relied upon for the narrow teaching of using pixels with sidewalls that are particularly V-shaped. Rather, Chen was relied upon for the teaching that QGIPs can be alternatively formed with a 2-D grid of grooves as well as with 1D grooves. Restated, Chen was provided for the suggestion that as an alternative to forming the physical cavities or voids as squares (Choi, FIG 7) or rectangles/1D slits (Choi, FIG 6), a QGIP can employ a 2D array of voids (such that the QGIP resembles a "photographic negative" of Choi's FIG 7).

a. Further, none of Chen's additional or different teachings "teach away" from Choi; Chen does not say that the use of straight sidewalls is bad or should be avoided. Rather, Chen specifically teaches that the poorer performance of their 2D QGIPs relative to their 1D QGIPs is specifically due to the fact that their etching process causes slanted, inverse-V grooves, and that other etching methods (/sidewall profiles) should be investigated.

9. Applicant argues that Choi does not teach that the optical cavity is " in resonance with the wavelength" absorbed by the recited quantum-well structure. The examiner disagrees: Choi teaches that the widths of the physical cavities or slits are on the order of a small number of wavelengths of the IR radiation, causing the desired refraction to occur. (see e.g., col. 6, lines 57-). This is the exact same phenomenon that occurs in Applicant's QGIP.

10. Applicant argues that Choi discloses "physical cavities" while Applicant's invention is directed towards an "optical cavity." However, these differences in terminology employed do not negate obviousness because the functions of Choi's and the present invention's structures are the same: QWIP stacks with grooves—or physical cavities—etched therein such that the entire structure forms an optical cavity. There is no *ipisimis verbis* requirement for a determination of anticipation or obviousness.

11. Applicant argues that the optical cavity of the present invention is a device that is specific to a resonance wavelength and strongly depends on the detection wavelength. This statement conflicts with Applicants' specification. The specification states the stack columns may detect radiation of one or more colors (e.g., page 4, liens 19-25) and that Applicant's device has a broader bandwidth than the conventional QWIP, allowing detection of different wavelengths (e.g., page 5, lines 25-30).

12. Applicants' arguments relating to why Choi and Chen are not properly combinable were already discussed hereinabove. It suffices to further note that one cannot show nonobviousness by attacking references individually where the rejections are based on combinations of references. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981); *In re Merck & Co.*, 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986).

Allowable Subject Matter

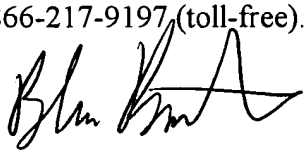
13. The following is a statement of reasons for the indication of allowable subject matter: the claims may be allowable, subject to further consideration and an updated search, if the independent claim(s) are amended to further properly specify that each isolated column possesses a respective grating tooth.

Contact Information

Any inquiry concerning this communication or earlier communications from the examiner should be directed to B. William Baumeister whose telephone number is (571) 272-1722. The examiner can normally be reached on M-F 8-5.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Tom Thomas can be reached on (571) 272-1664. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



B. William Baumeister
Primary Examiner
Art Unit 2815

September 15, 2004